# New Soil, Ground Water and Sediment Standards and Modified Generic Risk Assessment (Tier 2)

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# Overview

**Standards Update**

- Background
  - Standards and the component process
  - Why change was needed
- Overview of Changes Made

**Modified Generic Risk Assessment (MGRA or Tier 2)**

- Background and Introduction

**The MGRA Model**

- Interim Submission Process for an RA using the Model (before July 2011)
- Introduction to the MGRA Model

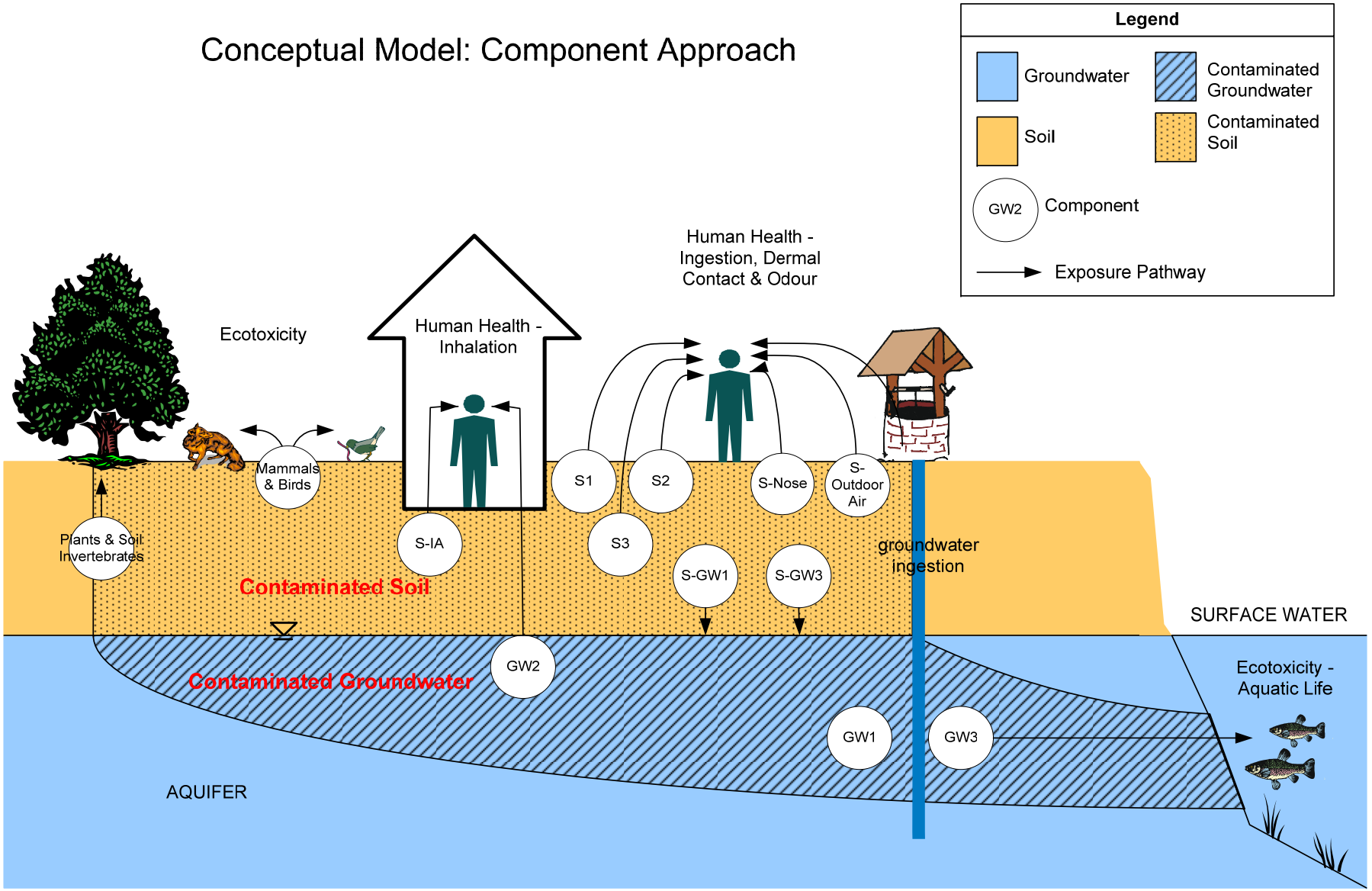
# Background

- Tables of Site Condition Standards
  - Referred to in the Record of Site Condition Regulation (O. Reg 153/04, Sections 34-43.1) where applicable site condition standards are prescribed, with respect to site characteristics and proposed uses
  - Where an RSC is being submitted, contaminant concentrations at an RSC property must meet the applicable site condition standard or the standards specified in a risk assessment

# Background

- Tables of Site Condition Standards
  - The standards are often referred to as generic or Tier 1 standards
  - Generic standards must be suitable for the vast majority of sites across Ontario
  - Must provide protection for human health and appropriate ecological receptors under a wide range of conditions.
  - These generic standards are therefore designed to protect numerous receptors from exposure from a number of pathways

# Conceptual Model: Component Approach



# Background

- Tables of Site Condition Standards in Reg 153/04 needed updating
- 2004 Standards were developed in 1985 – 1996
- Science is now over a decade old
- Improved models and parameterization were available
- Comments from stakeholders needed to be addressed

# Consultation on the Standards

- Extensive consultations were undertaken and amendments reflect stakeholder concerns.
- **Consultation and engagement activities included:**
  - **EBR Posting** of Proposed Soil and Groundwater Standards (March 2007 – 60 days), 33 submissions received (341 distinct comments)
  - **EBR Posting** (Oct. 2008 – Feb. 2009), 87 submissions received
  - Over 20 **face-to-face** information sessions
  - **Desktop Demonstration Pilots** to test proposed changes in specific sites:
    - For sites where the MGRA model can be used, the model (with site specific characteristics and risk management measures (RMMs)) typically offers a cost saving as compared to current (2004) standards
  - **Meetings organized by MMAH Brownfield Coordinator**

# Why Change was Needed

- **Human & Ecological Receptors**
  - Some toxicity data were out of date (some ecotox data missing)
  - Protection for terrestrial mammals and birds missing
- **Modelling**
  - New knowledge → need to update subsurface modelling
  - Soil to Indoor air scenario not realistic for commercial/industrial settings
  - Identified contaminants of concern (COCs) without standards
  - Lack of transparency e.g. 31x factor for source depletion
- **New information from CCME work now available**
- **Modified Generic Risk Assessment:** 1996 models didn't allow site-specific modifications

# Overview of Changes Since 2004

- **Human & Ecological Receptors**
  - Updated toxicity and ecotoxicity data
  - Mammals and birds modelled; updated plant and soil invertebrate calculations
- **Modelling Considerations**
  - Tables added for shallow soils and for sites near water bodies (within 30 m)
  - New models for soil to outdoor air & soil to drinking water added
  - Improved J&E model for soil to indoor air & GW to indoor air (handles shallow soils); added industrial/commercial indoor air scenario
  - Updated physical/chemical parameter data and laboratory Reporting Limits
  - Better PHCs & vinyl chloride modelling (including: non-potable GW numbers for PHCs; degradation of chlorinated ethylenes to VC accounted for)
  - Added 6 contaminants of concern
  - Calculated source depletion (to replace 31x factor)
  - Odour threshold-based values replaced artificial ceilings
  - Free phase threshold calculations replaced subjective ceiling values in soil
- **Incorporation of new information from CCME work**
- **Modified Generic Risk Assessment Model** now available

# Comparisons of Changes

| Final 2009 Standards: | Compared to 2004 Standards |
|---|---|
| **Less stringent (higher concentration)** | 23% (27) |
| **More stringent (lower concentrations)** | 65% (78) |
| **Equally stringent (unchanged)** | 8% (9) |
| **New/removed standards** | New standards: 5% (6) |

*"New standards are comparable to other jurisdictions that recently updated their standards"*

From report by *Stantec* consultants (commissioned by BILD/OHBA)

# Examples of Updated Standards

## Selected Soil Standards in 2004 and 2009

- **Residential coarse soil, potable full depth scenario** (in mg/kg)

| Chemical | 2004 | 2009 |
|---|---|---|
| **Benzene** | 0.24 | 0.21 |
| **Benzo(a)pyrene** | 1.2 | 0.3 |
| **Lead** | 200 | 120 |
| **PHC F1** | 30 | 55 |
| **PHC F2** | 150 | 98 |
| **PHC F3** | 400 | 300 |
| **PHC F4** | 2800 | 2800 |
| **PCBs** | 5.0 | 0.35 |
| **Tetrachloroethylene** | 0.45 | 0.28 |
| **Vinyl Chloride** | 0.003 | 0.02 |
| **Xylenes** | 25 | 3.1 |
| **Zinc** | 600 | 340 |

# Examples of Updated Standards

## Selected GW Standards in 2004 and 2009

- **Potable Groundwater** (in ug/L)

| Chemical | 2004 | 2009 |
|---|---|---|
| **Benzene** | 5.0 | 5 |
| **Benzo(a)pyrene** | 0.01 | 0.01 |
| **Lead** | 10 | 10 |
| **PHC F1** | 1000 | 750 |
| **PHC F2** | | 150 |
| **PHC F3** | 1000 | 500 |
| **PHC F4** | | 500 |
| **PCBs** | 0.2 | 3 |
| **Tetrachloroethylene** | 5.0 | 1.6 |
| **Vinyl Chloride** | 0.5 | 0.5 |
| **Xylenes** | 300 | 300 |
| **Zinc** | 1100 | 1100 |

# The New Standards

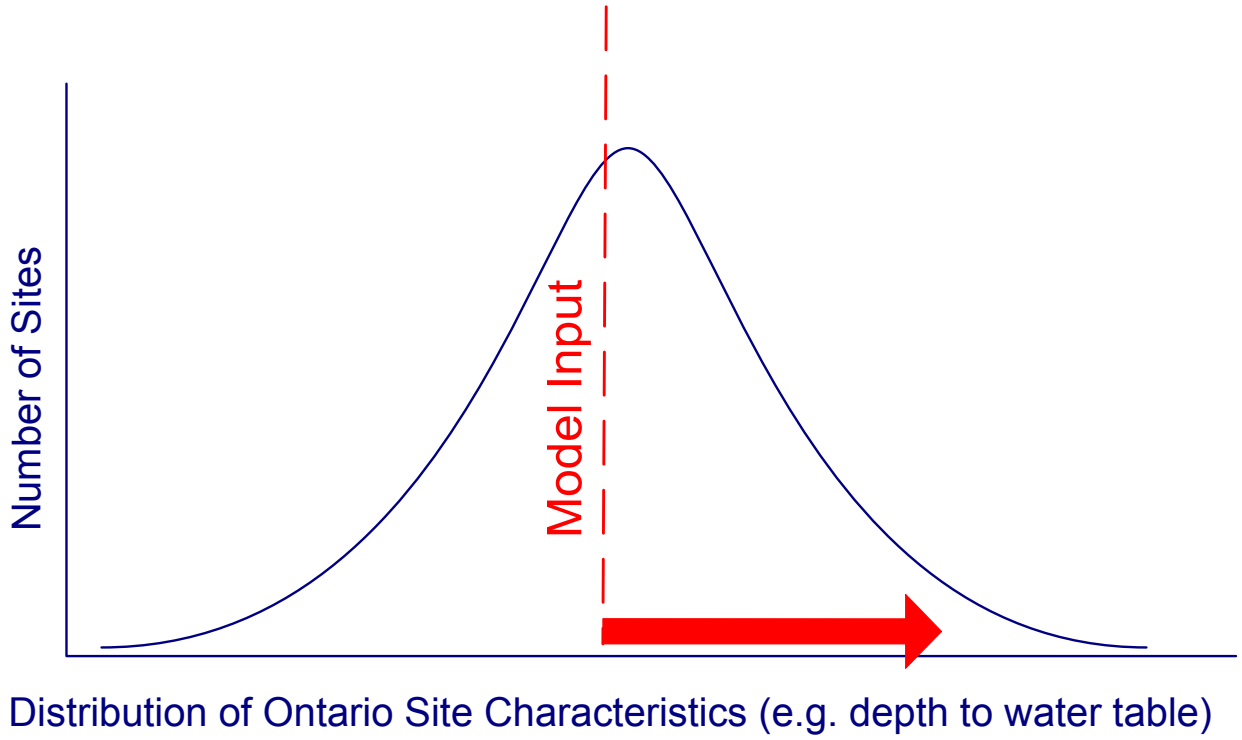
- The new standards:
  - Reflect current science
  - Provide a flexible approach to standards by: providing 4 new generic tables for simple application (Tables 6 to 9 for shallow soils and for sites within 30 m of a water body)
  - Provide a new standard model as a basis for modified generic (Tier 2) risk assessment submissions

- Due to use of source depletion, soil standards and Tier 2 are not intended for use at sites where there is a continuing source (same as 2004)

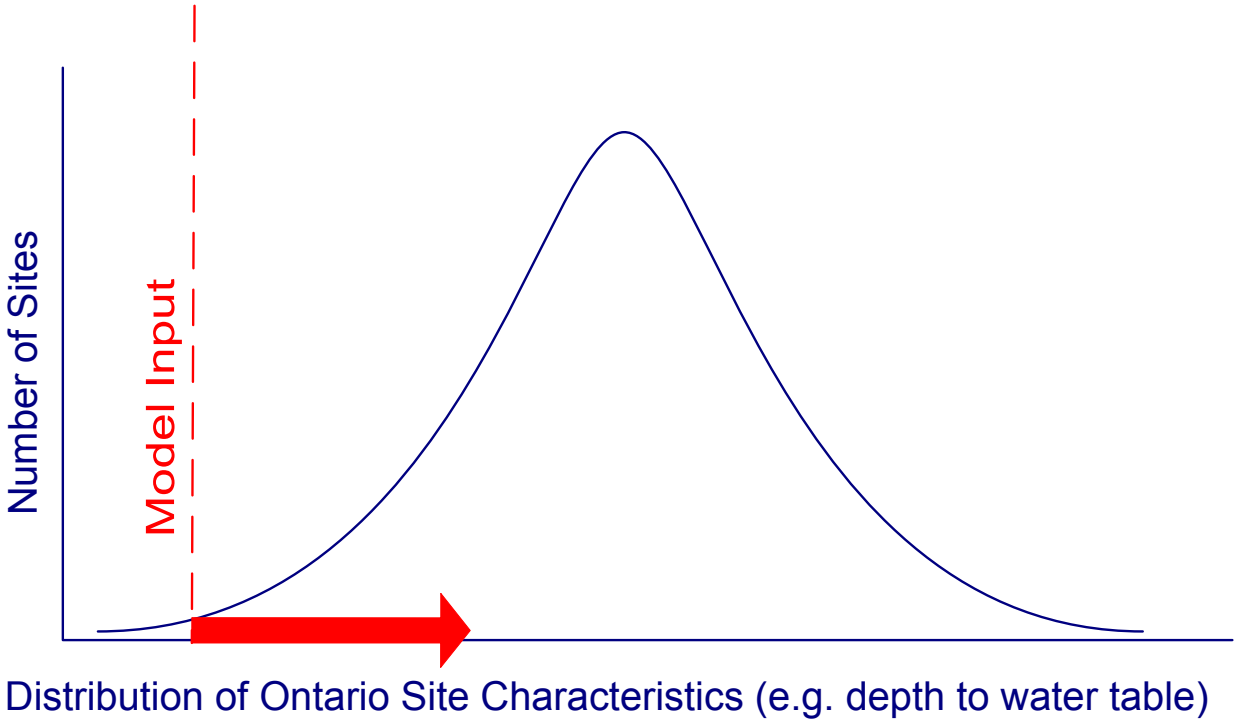
# Modified Generic Risk Assessment (MGRA, aka Tier 2)

- **Purpose of MGRA (Tier 2):**
  - Provide a streamlined alternative to meeting generic standards and Tier 3 risk assessment process
    - Site specific standards can be developed using the “approved model” (aka Tier 2 or MGRA model) using site specific data rather than the generic assumptions which underlie the Ontario-wide generic standards
    - Like other RA-derived standards, these are as protective of public health and the environment as the generic standards.
  - Provide proponents with a web-based tool for the development of these site specific standards

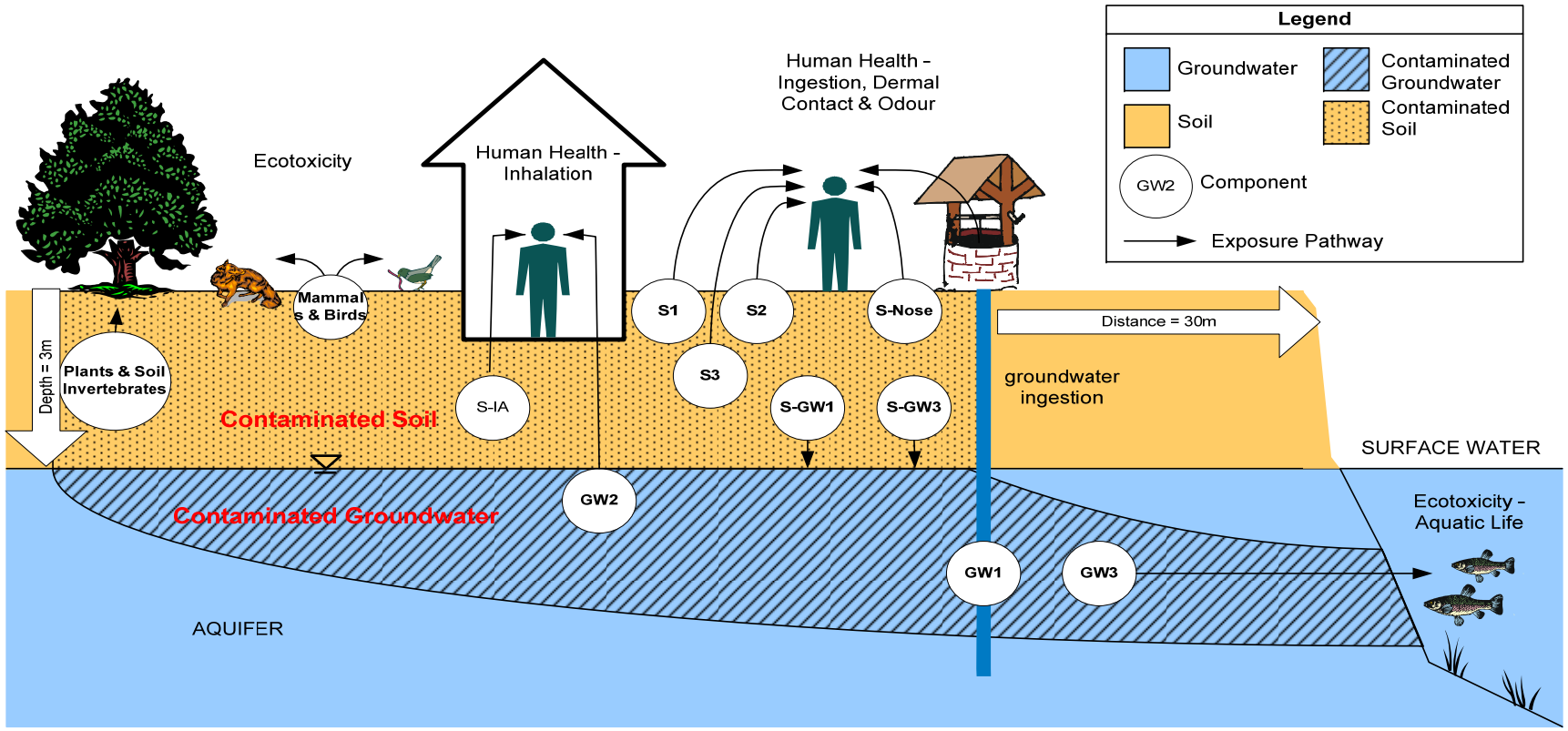
# Generic Model Inputs



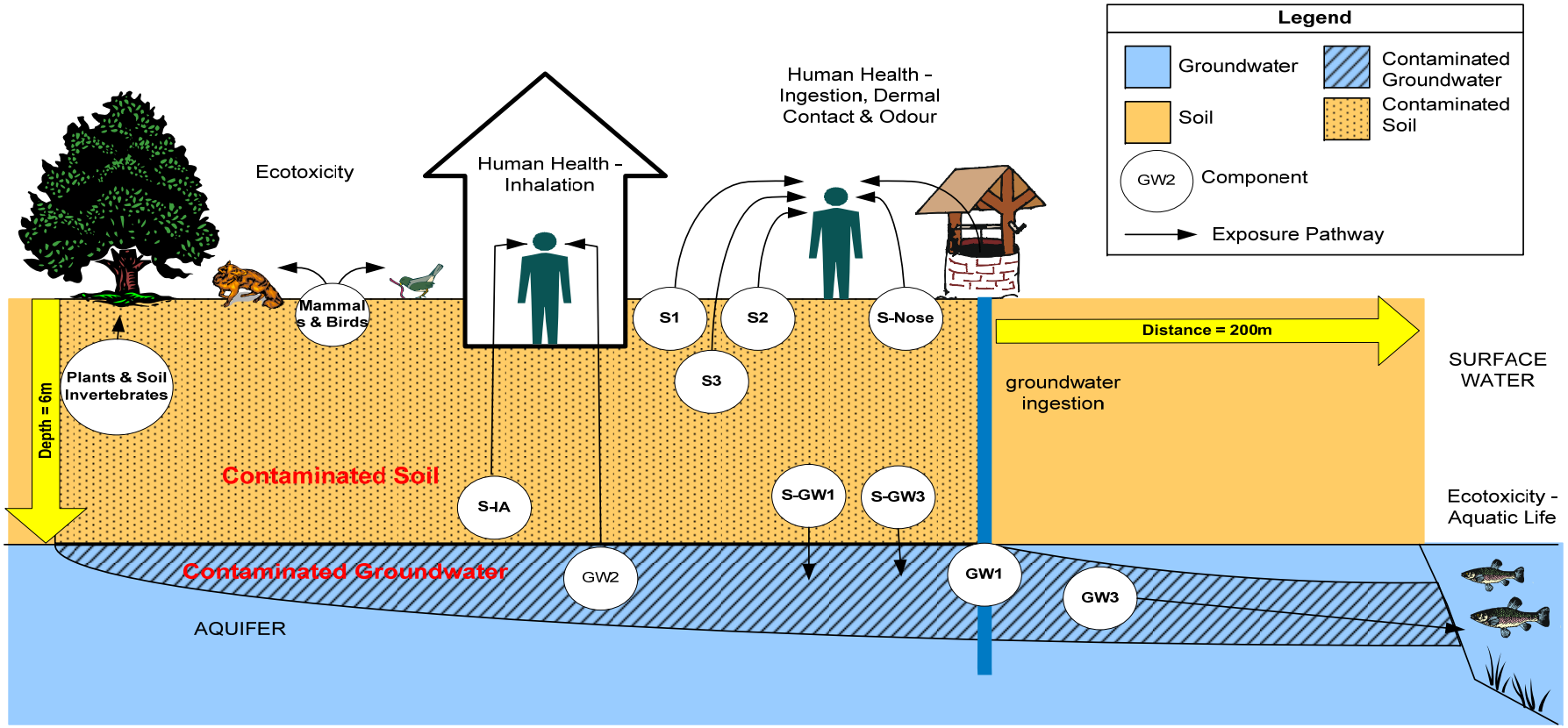
# Site Specific Model Inputs



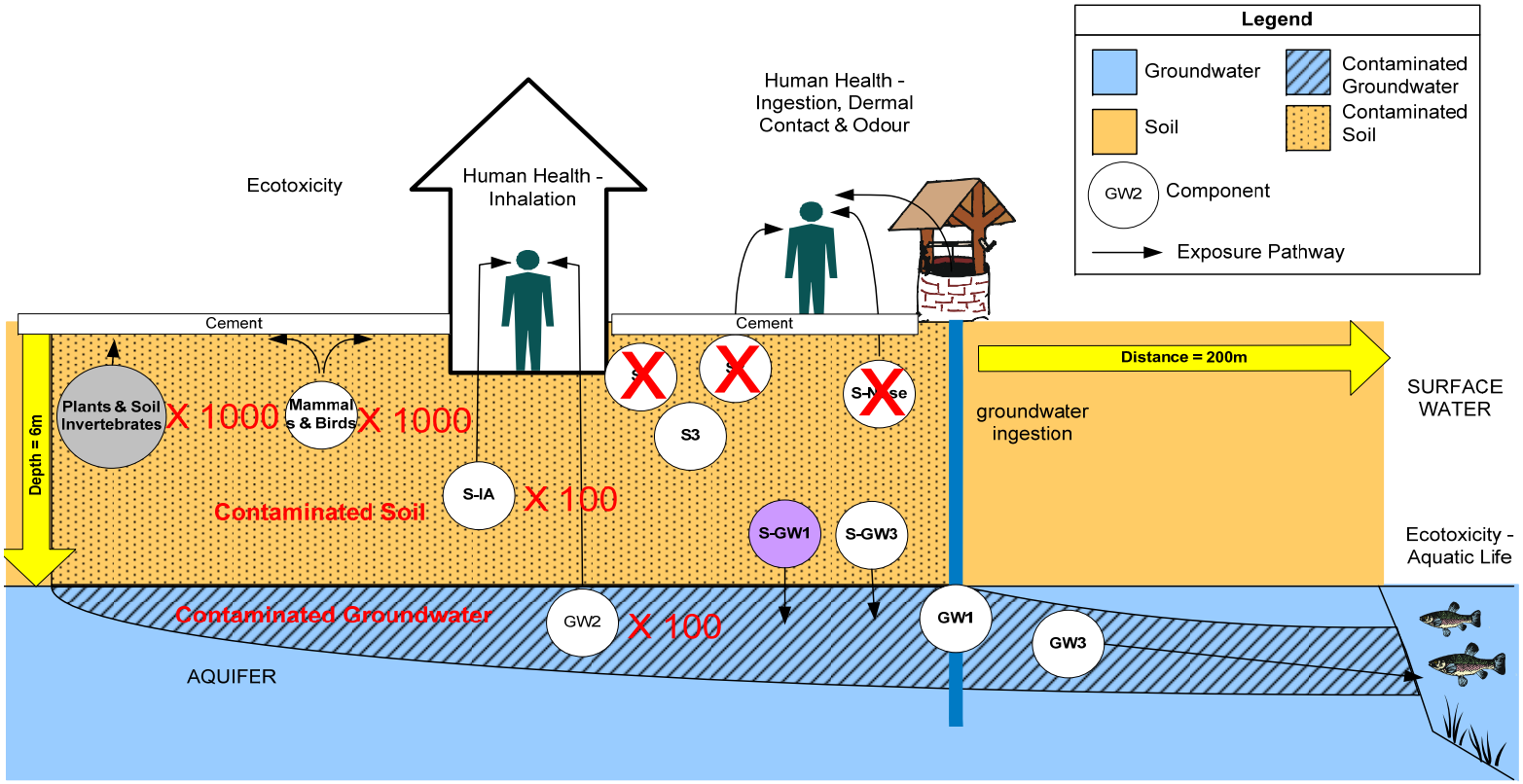
# Conceptual Site Model: Generic



# Conceptual Site Model: Site Specific Conditions



# Conceptual Site Model: Site Specific Conditions + SV Screening + Risk Management



# Modified Generic Risk Assessment, *continued* (Schedule C, s. 4&7)

- **Requirements for MGRA (Tier 2):**
  - An MGRA:
    - Uses the "Approved Model"* in a manner that is appropriate to the characteristics of the RA property;
    - Is submitted in a template provided by the Ministry
    - Changes to model default values *(assumption values in assumption categories)* must agree with results of properly conducted Phase 2 ESA *(environmental site assessment)*
      - The Phase 2 ESA determines what the value should be at the site (Schedule C, s. 7(3) and Schedule E, Table 4).
  - Mandatory appendix – MGRA appendix from Phase 2 ESA report (Schedule E, Table 1)
- ** Note that the "MGRA model" or "Approved Model" can be used in either a MGRA (Tier 2 RA) or a full (Tier 3) RA. For an RA to be considered an MGRA, the above requirements must be met.*

# Modified Generic Risk Assessment, *continued* (Schedule C, s. 7)

- **An MGRA shall NOT be submitted if:**
  - Section 41 of O. Reg. 153/04 applies:
    - The soil at the property has a pH < 5 or > 9 for surface soil and/or a pH < 5 or > 11 for subsurface soil;
    - The property is within, or includes, or is adjacent to, or includes land within 30 m of an Area of Natural Significance;
    - ***Note**: the "approved model" **may** be used in an RA (including an MGRA), where the RA property is a shallow soil property or one which includes land within 30 metres of a water body, as both are captured in the model and are not referred to in the amended Section 41*
      - *Assuming that no other aspect of amended Section 41 applies*
  - Any Risk Management Measure (RMM) other than an RMM designed and published for use in a MGRA (i.e., included in the "Approved Model") is used
- As with all RAs, only QPRAs may submit an MGRA

# Modified Generic Risk Assessment

## What Makes it Streamlined? (Schedule C, Section 7)

- **MOE "Approved Model" – based on model for generic standards**
  - Specific phase two ESA work must be carried out before user can change default values for site-specific parameters (Schedule E, Table 4)
  - Upper and lower limits set in the model for all parameters
- **Risk Management Measures**
  - Only the six (6) risk management measures included by the MOE "approved model" may be used
- **Faster Review for MGRA***
  - PSF and RA submitted together (Schedule C, Section 3 (1))
  - 8 week review timeline* (Section 46 (1))

***Note**: This timeline applies to MGRAs (NOT to RAs which use the "approved model" but are not MGRAs), and only applies after July 1, 2011 in force date.*

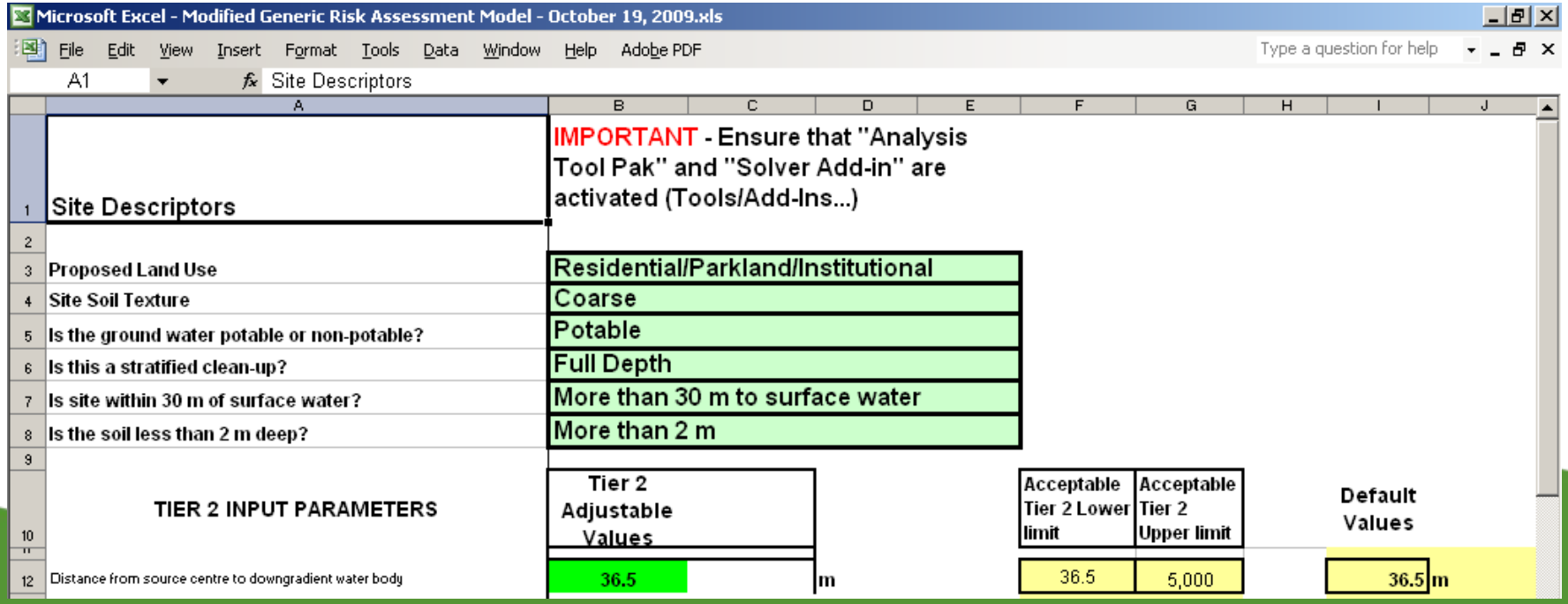
- **CPU not posted to EBR** (O. Reg. 681/94 and 73/94)

# Modified Generic Risk Assessment "Approved Model"

- **Features of the "Approved Model"**
  - 11 site parameters that can be altered by the QPRA
  - Measures that modify components or pathways:
    - RMM (CPU typically required)
      - Caps: hard cap, fill cap, shallow soil cap
        - » Descriptions in the Tier 2 model spreadsheet
        - » **Note: hard caps may be applied to a **part** of a site (e.g: to represent a parking lot)*
      - Building restrictions: no buildings; presence of parking garage; first floor non-residential
    - Modified Ecological Protection
    - Development of soil vapour screening levels to modify soil and/or groundwater to indoor air pathway

# Modified Generic Risk Assessment, *continued* (Schedule C, s. 1)

- **The "Approved Model" (aka Tier 2 or MGRA model)**
  - Data file titled "Modified Generic Risk Assessment Model" and dated October 19, 2009, as amended from time to time
  - Available on the Internet at: (http://www.ene.gov.on.ca/envision/land/decomm/condition.htm)


Microsoft Excel - Modified Generic Risk Assessment Model - October 19, 2009.xls
File Edit View Insert Format Tools Data Window Help Adobe PDF
Type a question for help
A1
Site Descriptors
Site Descriptors
IMPORTANT - Ensure that "Analysis Tool Pak" and "Solver Add-in" are activated (Tools/Add-Ins...)
Proposed Land Use
Residential/Parkland/Institutional
Site Soil Texture
Coarse
Is the ground water potable or non-potable?
Potable
Is this a stratified clean-up?
Full Depth
Is site within 30 m of surface water?
More than 30 m to surface water
Is the soil less than 2 m deep?
More than 2 m
TIER 2 INPUT PARAMETERS
Tier 2 Adjustable Values
Acceptable Tier 2 Lower limit
Acceptable Tier 2 Upper limit
Default Values
Distance from source centre to downgradient water body
36.5
m
36.5
5,000
36.5
m

# Using the Approved Model before July 1, 2011

- **A Technical Update has been posted online:**
  - "Technical Update – MGRA Approved Model Interim Use" www.ene.gov.on.ca/envision/land/decomm/condition.htm
- **Key points:**
  - An RA using the "Approved Model" may be submitted under the existing process.
    - All timelines and submission requirements same as the current Tier 3 RA process
  - **This is not a modified generic risk assessment or limited scope risk assessment.**
  - Recommendation: use the cover letter found in the Technical Update (Appendix A) to flag the RA, if you have followed all included tips and recommendations

# Brownfield Desktop Demonstration: Overview of Tier 2 Results

- **Cost Savings:**
  - Business cost savings and reporting savings can be obtained through the shorter review timeline
  - Savings on clean-up costs can be obtained through Tier 2
  - When compared with clean up to 2004 standards:
    - The majority of sites saw significant savings when Risk Management Measures were used
    - Some sites also saw savings when users altered site specific characteristics *only*
- **Applicability:**
  - Depends on the proposed land use and flexibility/creativity of the QPRA
  - "Tier 2" worked best for sites having the following characteristics: low-moderate measured contaminant values, moderate-deep water table depths, absence of free phase products

# Introduction to the MGRA Model

- A brief overview of:
  - The MGRA Model
  - For more information, please see the MGRA User Guide:
    - www.ene.gov.on.ca/publications/7380e.pdf
    - **Note:** the User Guide includes a step-by-step walk-through of the model, as well as a helpful chart of which pathways are affected by site-specific input parameters, and other helpful appendices.

# Example of Tier 2 Results for 12 common contaminants

Full Depth Potable, Residential - FOC = 0.01 in soil and 0.002 in aquifer +100m to surface water - Risk Management = underground parking garage and asphalt cap

| Contaminant | Generic Standard | Tier 2 Standards: Site Specific Parameters Only | Tier 2 Standards: with Risk Management |
|---|---|---|---|
| Benzene | (0.17) 0.21 | (0.17) **0.41** | **(1.3) 1.6** |
| Benzo(a)pyrene | 0.3 | 0.3 | **3.6** |
| Lead | 120 | 120 | **1000** |
| PHC F1 | (65) 55 | **(210) 140** | **(320) 510** |
| PHC F2 | (150) 98 | (150) 98 | **(1100) 2000** |
| PHC F3 | (650) 300 | **(1300)** 300 | **(7200) 8400** |
| PHC F4 | (5000) 2800 | **(5600)** 2800 | **(8000) 12000** |
| PCBs | 0.35 | 0.35 | **4.1** |
| Tetrachloroethylene | (2.3) 0.28 | (2.3) **0.53** | **(2.5) 2.1** |
| Vinyl Chloride | (0.022) 0.02 | (0.022) 0.02 | **(0.25) 0.21** |
| Xylene | (25) 3.1 | (25) **6.2** | **(66) 120** |
| Zinc | 340 | 340 | **(24000) 15000** |

# Environmental Site Assessment for MGRA (Schedule E, Table 4)

- The following slides describe the prescribed Phase Two ESA work.
  - changes to model default values must be in accordance with Schedule E, Table 4

# MGRA modifiable assumptions

**("Assumption Category" in Schedule E, Table 4)**

Depending on site characteristics, $QP_{RA}$ might decide to change 1 or more of the following:

- Fraction of Organic Carbon
  - Upper 0.5 m
  - Water Table to Soil Surface
  - Aquifer
- Distance to Water Body (nearest downgradient)
- Depth to Water Table (highest annual)
- Aquifer Horizontal Hydraulic Conductivity
- Aquifer Horizontal Hydraulic Gradient
- Soil Type (vadose zone and capillary fringe)
  - Applicable to the entire property
  - Applicable for each area where volatile contaminants are present in soil or GW
- Soil Vapour Concentrations and Depth to Soil Vapour Measurements
- Number of Frozen Days

**Appendix 5: Chart to identify which Tier 2 input parameters affect which pathways (subsurface transport components)**

| Pathway\Tier2 Input Parameters | S-IA* | S- Odour | S-GW1 | S-GW3 | S-OA | GW1 | GW2 | GW3 | Free Phase Threshold |
|---|---|---|---|---|---|---|---|---|---|
| Distance to surface water | NA | NA | NA | ✓ | NA | NA | NA | ✓ | NA |
| Soil FOC – water table to soil surface | ✓ | NA | ✓ | ✓ | ✓ | NA | NA | NA | ✓ |
| Soil FOC – upper 0.5m | NA | ✓ | NA | NA | NA | NA | NA | NA | NA |
| Depth to water table | NA | NA | NA | NA | NA | NA | ✓ | NA | NA |
| Property Soil Type – vadose zone | ✓ | ✓ | ✓ | ✓ | ✓ | NA | ✓ | NA | ✓ |
| Property Soil Type – capillary fringe | NA | NA | NA | NA | NA | NA | ✓ | NA | NA |
| # Frozen Days | NA | ✓ | NA | NA | NA | NA | NA | NA | NA |
| Aquifer horizontal hydraulic conductivity | NA | NA | NA | ✓ | NA | NA | NA | ✓ | NA |
| Aquifer horizontal hydraulic gradient | NA | NA | NA | ✓ | NA | NA | NA | ✓ | NA |
| Aquifer dry bulk density | NA | NA | NA | ✓ | NA | NA | NA | ✓ | NA |
| Aquifer FOC | NA | NA | NA | ✓ | NA | NA | NA | ✓ | NA |

* Best method to do Tier 2 on S-IA pathway is using soil vapour screening methods as described in the body of this document.

NA = not applicable for pathway; ✓ = applicable for pathway

Relationship between assumptions and generic SCS pathways

Source: MGRA User Guide

# Fraction of Organic Carbon

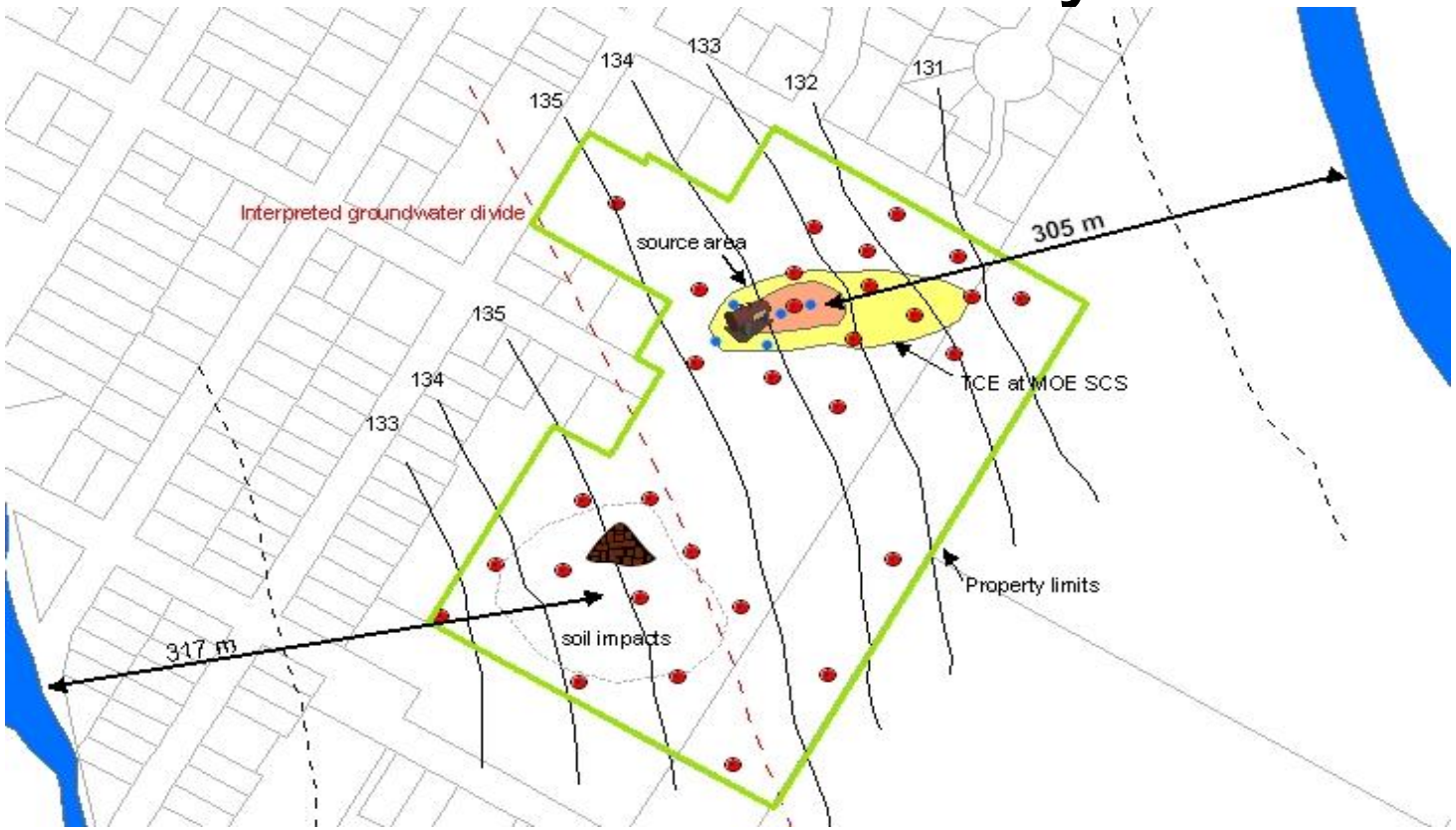
## (Water Table to Soil Surface)

Schedule E, Table 4, Assumption Category, Item 1

1. Samples of soil from at least four continuous borehole cores,
2. At least one composite sample from each of 4 locations representative of natural (non-anthropogenic) FOC is required. The samples must be taken from soil of the same soil type present in an area where a contaminant is present at a concentration greater than the applicable SCS.
3. Each sample shall be analyzed in triplicate,
4. The FOC for the property is the mean of samples analyzed, and
5. At least one soil sample shall be taken at each of the four sampling locations and analyzed for the contaminants of concern.

Note: For requirements for FOC in the upper 0.5 m and the aquifer, please refer to Schedule E, Table 4, Assumption Category, Items 2 and 7.

# Minimum Distance to Nearest Down Gradient Water Body



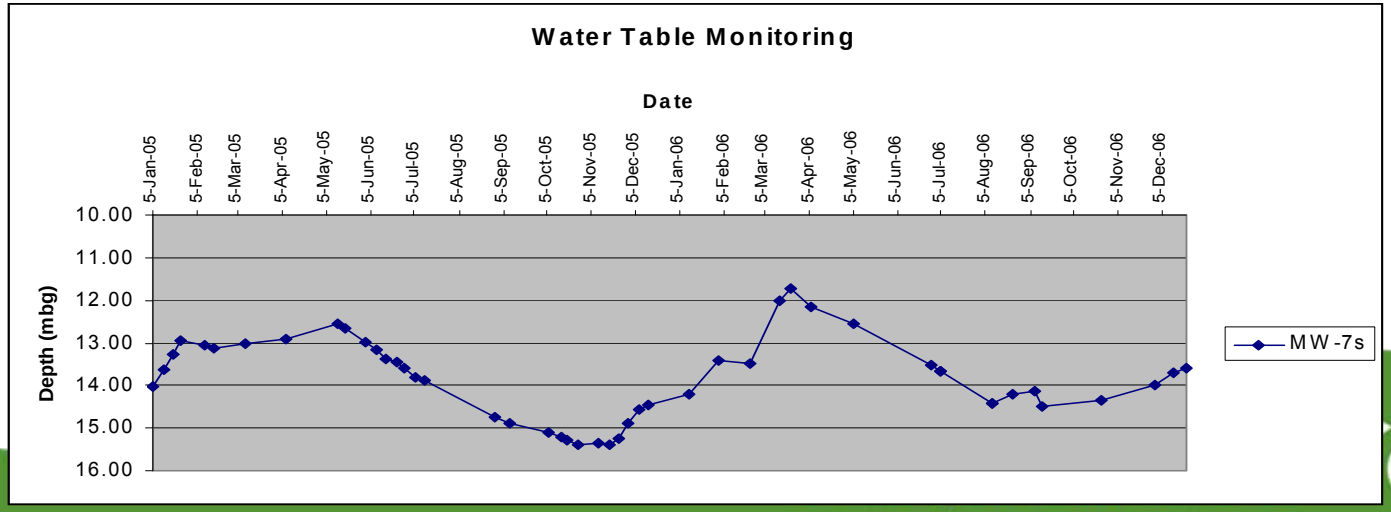

(Schedule E, Table 4, Assumption Category, Item 3)

# Minimum Depth Below Soil Surface to the Highest Annual Water Table

(Schedule E, Table 4, Assumption Category, Item 4)

Options:

1. If 2 years of water level monitoring (quarterly) available, then water table monitoring for three months during the season with the highest water table,
2. If no historical information available, then either:
   a) Monthly water table level monitoring for 12 months, or
   b) Identify the max. anticipated water level fluctuation and subtract it from water table measurement (at least 1 m shall be subtracted).

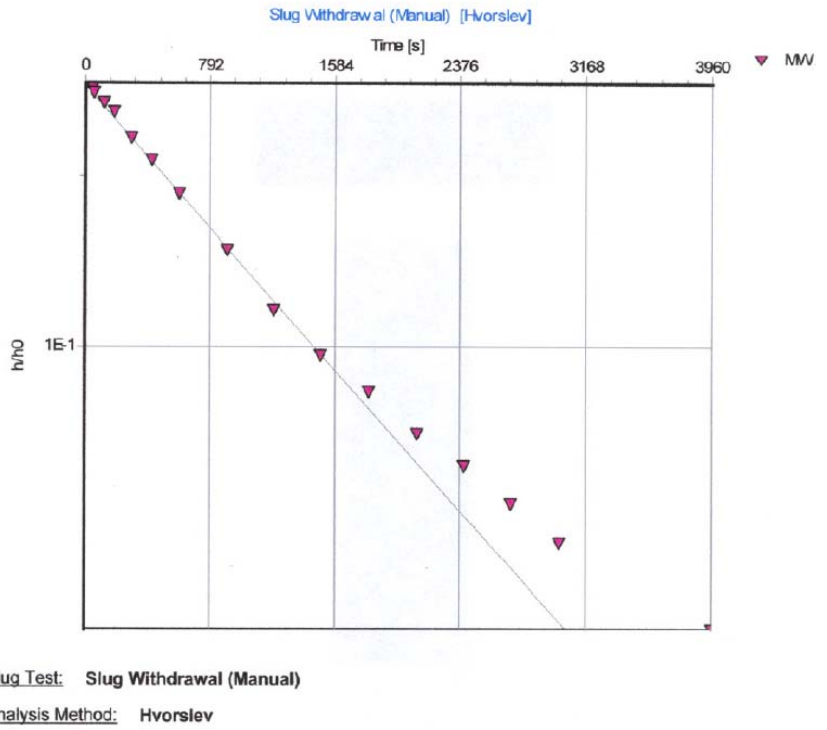


# Aquifer Horizontal Hydraulic Conductivity

(Schedule E, Table 4, Assumption Category, Item 5)

Options:

1. Field testing shall be conducted within the coarsest geological material in the aquifer which carries COC to a water body,
2. The hydraulic conductivity values from field testing should be consistent with published values associated with the geological material tested,
3. If the field testing values are not consistent with the published values associated with the geological material a multiplier shall be applied to the field testing values.

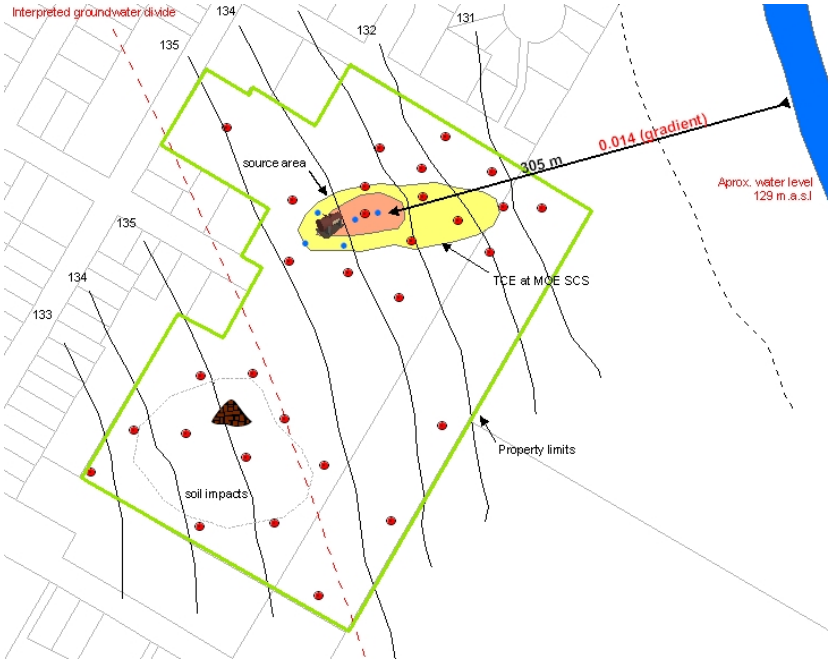


# Aquifer Horizontal Hydraulic Gradient

(Schedule E, Table 4, Assumption Category, Item 6)

Average horizontal hydraulic gradient between impacted aquifers and the nearest water body to which ground water discharges.

1. Water level measurements shall be taken from at least three monitoring wells from the same hydrostratigrapic unit,
2. Fluctuations of ground water flow direction shall be considered when selecting the monitoring wells,
3. Contours of the interpreted ground water surface shall be prepared for each of the impacted aquifers to determine the average hydraulic gradient in accordance with the regulation.



# Property Soil Type (Vadose Zone)

(Schedule E, Table 4, Assumption Category, Item 8)

**New definition**: soil type means soil texture class as determined pursuant to Figure 3.16 and Chapter 3 of the Soil Survey Manual, US NRCS.

In areas where a contaminant is present above the SCS the predominant soil type in the vadose zone shall be determined:

1. One or more boreholes must be advanced to the bottom of the an area where a contaminant is present at a concentration greater than the applicable SCS. In any other case one or more boreholes must be advanced to the top of the saturated zone.
2. At least 4 samples per vadose zone area shall be collected and analyzed for the determination of grain size, and the predominant soil type from among these areas determined based on the analysis and borehole information,
3. If two or more soil types exist in approximately equal amounts, the coarsest soil type shall be selected as the predominant type.

Note: The requirements for property soil type determination in the capillary fringe and determination of area soil type for vadose zone and capillary fringe are found in Schedule E, Table 4, Assumption Category, Items 9, 10 and 11.

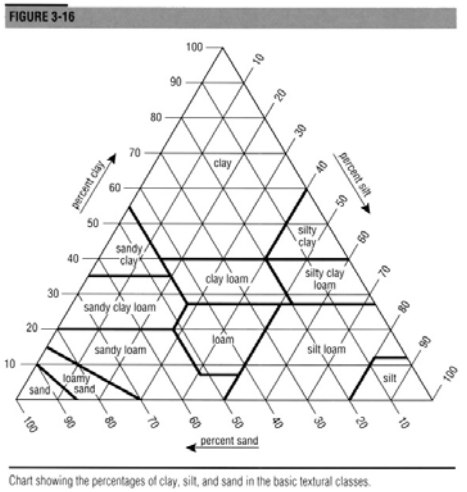
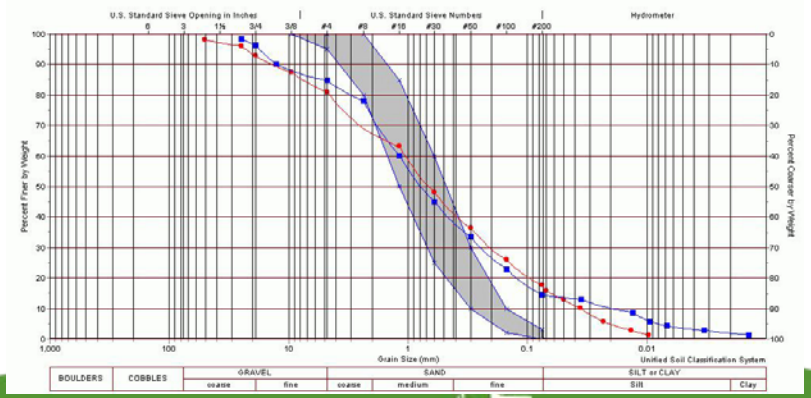


Chart showing the percentages of clay, silt, and sand in the basic textural classes.



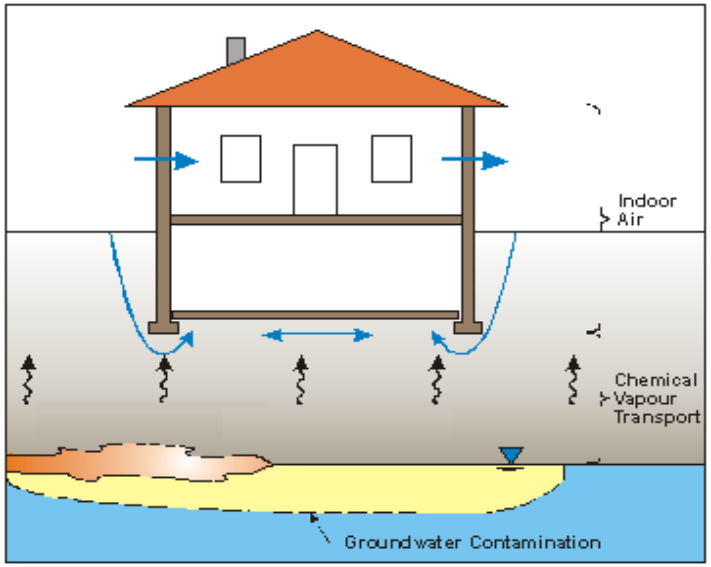
# Soil Vapour Intrusion Assessment

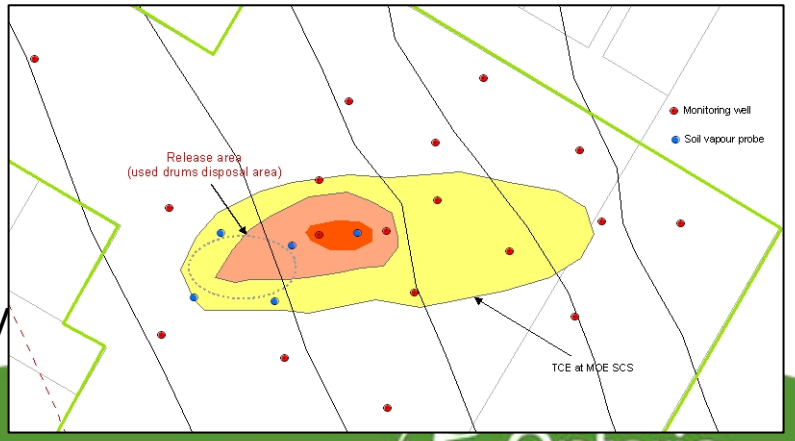
## Soil Vapour Sampling Locations

(Schedule E, Table 4, Assumption Category, Item 12)

Determine soil vapour concentrations in each area in which a VOC is present above SCS,

1. a sampling plan for soil vapour characterization shall be prepared to determine appropriate sampling locations and depths,
2. soil vapour samples shall be collected in areas where:
   a) known or inferred VOC release areas,
   b) the highest VOC concentrations in soil and/or ground water,
   c) the qualified person considers vapour intrusion related exposures may be of potential concern.
3. at the approximately the same depth as the highest soil concentration and/or top of capillary fringe in each sampling location.



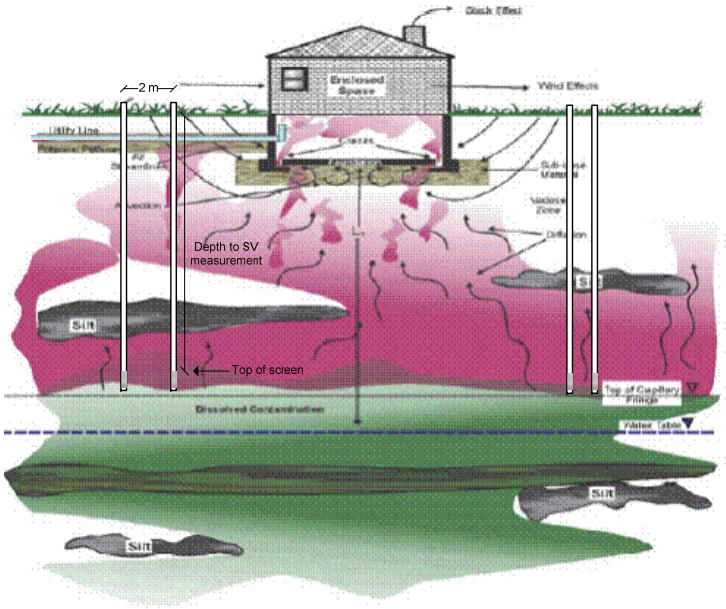
# Soil Vapour Intrusion Assessment

## Soil Vapour Measurements

The depth to soil vapour measurement is the distance from soil surface to the top of the probe screening interval for each soil vapour probe from which samples are collected.

The SV samples must be collected as follows:

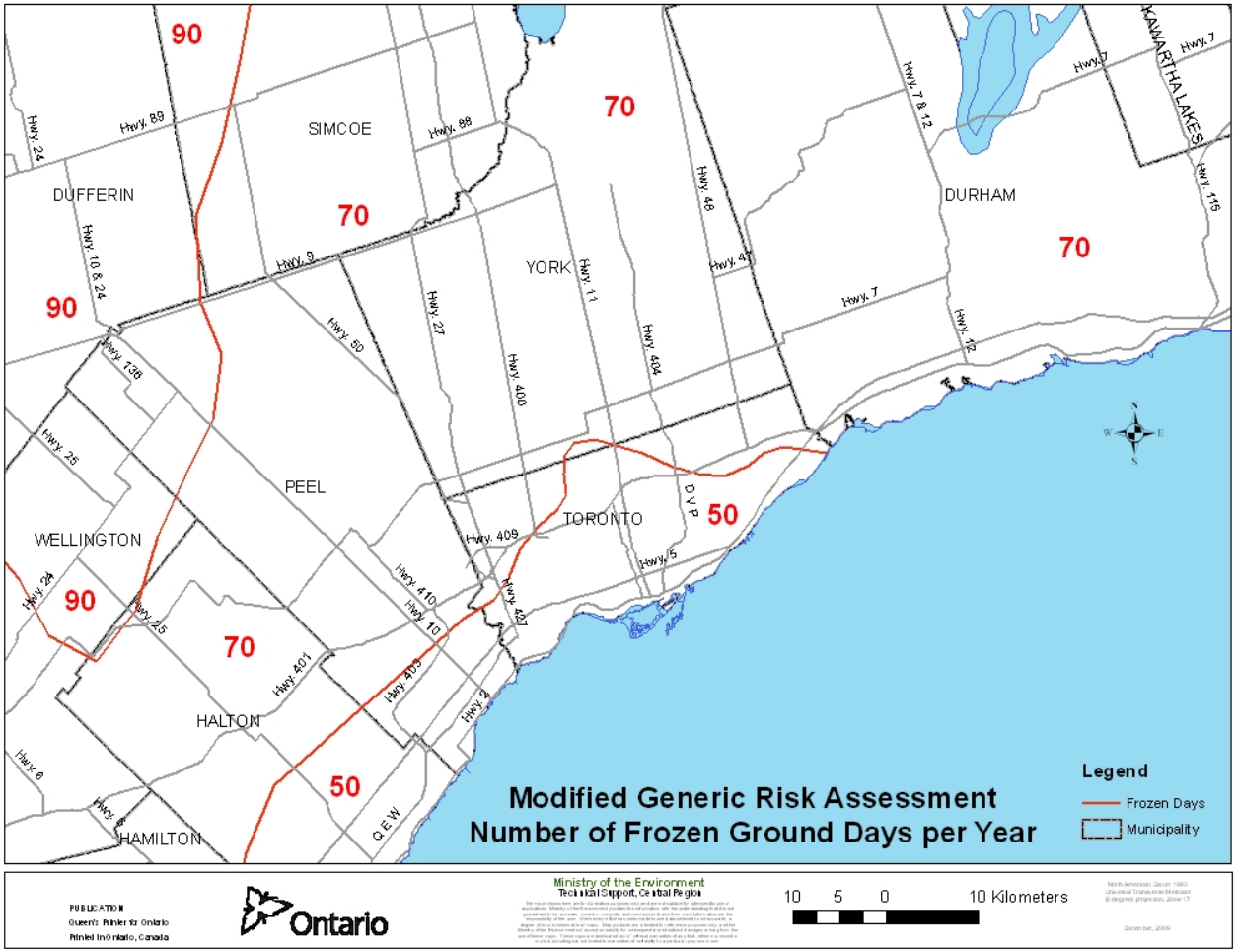
1. at least two SV probes per sampling location and depth (no multiple probes in a single borehole),
2. at least two SV sampling events separated by at least three months,
3. Samples shall be collected from at least 1.5 metres below the soil surface,
4. Screen intervals in SV probes shall not exceed 0.5 metres,
5. SV samples shall be collected using probes designed, constructed and operated to minimizes adsorption, desorption and leaks.




**Example of a Conceptual Site Model for Vapour Intrusion into a Residential Building (adapted from US EPA, 2002)**

(Schedule E, Table 4, Assumption Category, Item 12)

# Number of Frozen Days per Year



# Modified Generic RA
## Reporting Requirements

1. We expect that a standard MGRA template will be auto-populated by the IT system with some areas for the QPRA to complete and sign-off.
2. Additional information: (Schedule C, Section 4, sub-section 6, Para 4)
   a) A summary of the ESA investigation, including:
      i. justification for the sampling program
      ii. a summary of sampling and analysis QA/QC,
      iii. assessment of whether the sampling program is sufficient for RA (and if not, description of what further site investigations were conducted to support the RA), and
      iv. a rationale for and description which differs from the assumptions used in the development of the generic SCS.
   b) The MGRA appendix of the phase two ESA report (see Table 1, report section 10, subheading (d), of Schedule E),
   c) The phase two conceptual site model (see Table 1, report section 6, subheading (x), of Schedule E)

# Key O.Reg. 153/04 Sections

- Schedule C, Section 7: Limited scope risk assessment, defines MGRA;
- Schedule C, Risk Assessment Part I - Section 4 of Mandatory requirements of risk assessment reports, outlines minimum content of the ESA summary that needs to be included in the MGRA report.
- Schedule E sets out the Phase II ESA requirements for an MGRA:
  - Schedule E, Table 1: Mandatory Requirements for Phase Two ESA Reports – Appendix (d) Modified Generic Risk Assessment; and
  - Schedule E, sections 41, 42 and Table 4: Phase Two Environmental Site Assessment Requirements for Modified Generic Risk Assessments outlines objectives and minimum requirements when an assumption category is modified

# Contacts
# (for Standards Development Branch)

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  - Camilo.Martinez@ontario.ca; (416) 327-8220

# Resources (for Standards and MGRA)

- **EBR Site** (**EBR Registry Number:** 010-4642); right hand column, under “The documents linked below are provided for information purposes only”
  - 4. Overview Fact Sheet
  - 6. Risk Assessment Fact Sheet (focuses on Tier 2)
  - 7. Standards Fact Sheet
  - 9. Implementation and Transition Fact Sheet
  - 10. Soil, Groundwater and Sediment Standards (tables)
  - 13. Modified Generic Risk Assessment Model

# Resources (for Standards and MGRA), *con't*

- **RSC Site** (http://www.ene.gov.on.ca/envision/land/decomm/condition.htm)
  - 7379e: Technical Update - Modified Generic Risk Assessment Approved Model Interim Use (PDF) – December 2009
  - 7380e: User Guide - Modified Generic Risk Assessment Model (Spreadsheet Version) (PDF) – December 2009
  - 7381e: Modified Generic Risk Assessment Model (ZIP) – October 19, 2009
  - 7382e: Soil, Ground Water and Sediment Standards (PDF) – July 27, 2009